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Response to #A Madden-Julian Oscillation Event Realistically Simulated by a Global Cloud-Resolving Model#

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Science

Disclaimer

Response to "A Madden-Julian Oscillation Event Realistically Simulated by a Global Cloud-Resolving Model" *(1)*

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I agree with the authors that forecasting the Madden-Julian Oscillation (MJO) in a high resolution global model is important for numerous reasons, including improved weather forecast skill beyond 10 days, and resolving small scale features embedded in the MJO that coarse resolution (~100-300km horizontal grid spacing) climate models do not (e.g., tropical cyclones). Unfortunately, the authors promote the (incorrect) overall impression that coarse resolution climate models cannot simulate the MJO by (a) only discussing aspects of works that indicate the poor ability of coarse resolution climate models to simulate the MJO *(2, 3)*, and (b) by promoting the use of higher resolution models *(1)*, and the use of embedded two-dimensional cloud resolving models embedded in coarse resolution climate models *(4, 5)* as the principal methods for realistically representing the MJO because of the difficulty of coarse resolution models "to estimate the vertical redistribution of heat and moisture by unresolved convective clouds."

Regarding items (a) and (b), I have co-authored two of the works cited by Miura *et al.* that bemoan the poor ability of coarse resolution climate models to simulate the MJO *(2, 3)*, and indeed simulating the MJO in coarse resolution climate models is a grand challenge. However, I would like to draw to their attention to work that has demonstrated that two different coarse resolution climate models, using conventional parameterizations of convection and clouds, can represent the MJO with high fidelity *(6, 7)*. In the later study, where more complete model diagnostics were available, important aspects of the MJO that were realistically represented included the relationship between convection and low-level moisture convergence, surface fluxes, the vertical structure of

winds and divergence, and important air-sea interactions. Additionally, regarding item (b), convection is certainly of central importance in representing the MJO, but it is the interaction of convection (parameterized or otherwise) with other aspects of the model physics that is important. Thus, it is the implementation of the full physics package that is relevant, not simply the manner in which convection is represented.

The issue at hand is to determine what aspects of the physics present in the high resolution (and embedded 2-dimensional cloud resolving model) simulations are essential for incorporation into coarse resolution climate model parameterizations in order for them to adequately represent the MJO. In the foreseeable future, models used for climate and climate change studies will continue to require convective parameterization in order to produce simulations that span decadal to centennial time scales to estimate the impact of anthropogenic influences on the statistics of weather variability and extremes. As such, intercomparison across different classes of modeling is essential to better understand the physics relevant to the climate system.

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